Living with citrus greening in Florida

By Phil Stansly

Florida has the second largest orange industry in the world after Brazil, producing approximately 140 million boxes during the 2010-2011 season. Florida orange acreage has declined from 665,529 acres in 2000 to 473,086 acres in 2011. There are many reasons for the decline in acreage — primarily low fruit prices, but also inflated land prices, canker eradication and now, citrus greening disease, also known as huanglongbing (HLB) or yellow shoot disease in Chinese.

HLB is caused by the bacteria *Candidatus* liberibacter asiaticus (Cla), and was first detected in Florida in 2005, only seven years after discovery of the psyllid vector, *Diaphorina citri*, in 1998. In contrast, HLB was detected in Brazil in 2004, at least 60 years after *D. citri* was found there.

There are many parallels and interactions between the citrus industries of Florida and Brazil, and the short history of HLB is no exception. The basic strategies of clean nursery stock and vector control have been promoted and largely followed in both regions.

Rogueing of symptomatic trees to reduce inoculum, or "eradication" as it is termed in Brazil, is more controversial. Many Florida citrus growers, especially in the eastern and southern region of the citrus belt, have found their groves burdened with high incidence of HLB. Faced with the prospect of removing and replacing all trees without any assurance that the attendant costs will be recovered, many growers have opted, with apparent success, to prolong the productive life of infected trees with intensified programs of foliar nutrition to mitigate HLB symptoms, coupled with rigorous vector control to reduce reinoculation of the causal agent. While these efforts appear to be successful, the health and productive life of the next crop of trees now being planted or planned is still in question.

This article will describe vector management programs as they have evolved in the last six years in Florida.

HLB AND PSYLLID BASICS

Psyllids are sucking insects related to aphids and more distantly to whiteflies and other Homoptera. Young flush of citrus or near-citrus relatives such as *Murraya* is required for eggs to mature in the female ovaries and for development of nymphs. However, adults can survive long periods feeding on mature foliage, and to a lesser extent, on other types of plants. Cla is acquired most efficiently by nymphs feeding on HLB-infected plants, and to a lesser extent, by adult feeding. Therefore, most HLB-positive adults became infected as nymphs. While nymphs are primarily responsible for acquisition of Cla, they do not move from their shoots of origin and so cannot spread the disease unless they survive to adulthood and move to a different tree.

PATTERNS OF FLUSHING AND INFESTATION

When citrus is grown in or near the subtropics, winters are usually cool and/or dry enough so that trees enter into a quiescent state providing little or no flush for psyllid reproduction. Rising temperatures often accompanied by rain in spring induce trees to flush, which typically accounts for 75 percent of the year's growth of new foliage on mature trees in Florida. Psyllids that have survived the "dormant period" now find unlimited resources and reproduction proceeds unchecked. However, when the spring flush hardens off, the psyllid population goes on the move seeking new sources of flush and spreading the disease within and between groves. The key to Asian citrus psyllid (ACP) control is to curtail this process. Populations of both vector and pathogen tend to decrease in summer, but rebound somewhat in fall when a lesser bout of psyllid reproduction and disease spread occurs.

NATURAL ENEMIES AND BIOLOGICAL CONTROL

Natural enemies include predaceous insects such as ladybeetles and lacewings that are most active in spring and are attracted to young flush and the insects that feed on it such as aphids and psyllids. Other predators such as spiders and predaceous mites may be present throughout the growing season. Eggs and young nymphs may also be attacked by fungi such as *Hirsutella citriformis* during warm, humid conditions.

A parasitic wasp, *Tamarixia radiata*, has been either accidently or purposely introduced wherever ACP has established and, in Florida, can cause considerable mortality, especially in late season. Together, these natural enemies often cause 90 percent or more mortality to the psyllid population. Research is being conducted in Florida, Brazil, Mexico and elsewhere to evaluate the feasibility of increasing biological control through mass rearing and release of *Tamarixia radiata* in residential areas and commercial citrus. While biological control has not been sufficient to avoid greening, it still contributes significantly to suppression of psyllids and other pests, and should be considered an important component of citrus integrated pest management.

Figure 1. *"Tap" sample and appearance of psyllids on laminated sheet.*

MONITORING ACP

Yellow sticky cards, tap sampling for adults and visual inspection of young shoots are methods used for monitoring ACP populations All these methods have their place in ACP management.

Sticky cards are expensive, labor intensive and provide only delayed information. Nevertheless, they are useful for detecting psyllid movement into a block when placed around the perimeter.

The tap sample provides a rapid and reproducible index of adult ACP density as well as of numerous other pests and beneficial insects and mites. A randomly chosen branch is struck sharply three times with a PVC pipe or stick and the insects are counted that fall on a white laminated sheet or clip board held some 30 cm below (Fig. 1, previous page). The smooth surface inhibits the psyllids from taking flight. Taps are repeated on 10 trees per location in 10 locations per block to make 100 taps. Up to 10 young shoots are also inspected at each location to determine the percentage infested with any stage of ACP. The number of trees necessary to find these shoots is also noted as an index of flush density.

OPTIMIZING INSECTICIDAL CONTROL

Insecticides can be effective, but their use must be optimized to control costs, environmental and health risks, selection for resistance, resurgence of secondary pests and unacceptable residues. Unfortunately, threshold levels below which the spread of HLB will be reduced to a manageable degree are not yet known. However, research is showing that even infected trees will respond to psyllid suppression with insecticides. We have seen yield responses in HLB positive trees that were sprayed at least once in winter and later at a threshold of 0.2 adults per tap. The yield response was further enhanced if trees were sprayed on flush three times a year with a cocktail of macro and micro-nutrients.

Any application of insecticide will select for resistance in all exposed pest populations. Avoiding unnecessary applications and rotating modes of action (MsOA) in successive sprays are the best methods of slowing down this process. The grower should avoid repeating any particular MOA in the same year. Classification of insecticide MsOA can be found at http://www.irac-online.org/wp-content/uploads/2009/09/MoA_Classification.pdf.

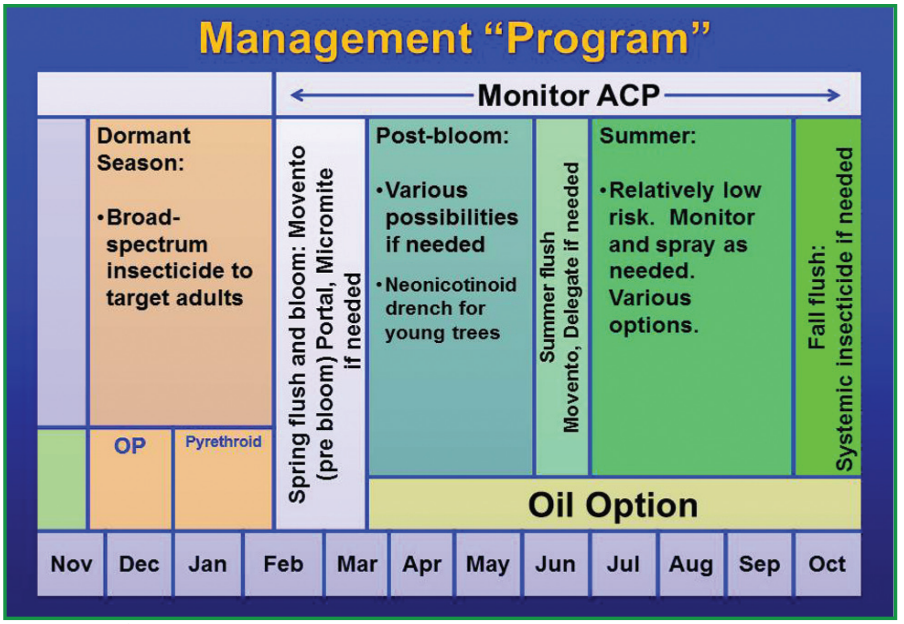

Figure 2. *Generalized program for insecticide applications*

YOUNG TREES

Young trees flush almost continuously, and thus require constant protection. The most effective way to accomplish this is with systemic insecticides applied as drenches or side dressings. Presently, only neonicotinoids such as imidacloprid and thiamethoxam are available for this purpose in Florida. Therefore, drenches must be alternated with foliar sprays with a different MOA, and neonicotinoids used sparingly or not at all as foliar sprays on mature trees to reduce selection for resistance to these essential products.

SPRAY TIMING – DORMANT SPRAYS

The declining population of ACP adults during the dormant season is especially vulnerable to broad-spectrum insecticide sprays. Another advantage is that many natural enemies are absent from the grove or hidden in quiescent hosts during this time. We have seen five to six months suppression from a single spray of organophosphate or pyrethroid in winter, greatly reducing ACP reproduction in the spring flush and thus subsequent spread of the disease, while having no effect on ladybeetles or lacewings. The dormant spray is the most effective and necessary spray of the year, and the one that should never be missed.

GROWING SEASON

Sprays during the growing season are best applied when need is indicated by monitoring results. Choice of insecticide will depend on which ACP life stage predominates, what other pests require suppression, and what MsOA have already been used. Selective insecticides are always preferable to conserve natural enemies. A generalized annual scheme is presented in Fig 2.

AREA WIDE MANAGEMENT

Dormant sprays applied on an area-wide basis have proved most effective in Florida. Citrus Health Management Areas (CHMAs) have been formed throughout the state in order to better coordinate psyllid management efforts (www.FLCHMA.com). Area-wide monitoring of psyllid populations is also being organized as part of the effort. This cooperative area-wide approach to ACP management promises to increase the effectiveness of all our control efforts.

Living with greening will require both a higher level of technology and greater cooperation than previously was the norm. We must do a better job working together to control pests while conserving or augmenting biological control. We must also become more adept at providing the tree everything it needs to reduce stress, and optimize growth and production on less land. These improvements in cultural practices will require significant changes, but they will be accomplished if the history of the Florida citrus industry is any indication.

Phil Stansly (pstansly@ufl.edu; www.imok.ufl.edu/entomology) is a professor of entomology at the University of Florida-IFAS' Southwest Florida Research and Education Center, Immokalee.